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RESEARCH ARTICLE

Redescription of *Malacomorpha cancellata* (Phasmatodea: Pseudophasmatidae): a geographically misplaced Neotropical species

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ABSTRACT. *Olcyphides cancellatus* Redtenbacher, 1906 was described from Canton, China, in error. The species was transferred to *Pseudolcyphides* Karny, 1923, a genus that later on was synonymized with *Malacomorpha* Rehn, 1906. However, the name *P. cancellatus* was forgotten and was not mentioned in the publication where *Pseudolcyphides* was synonymized with *Malacomorpha* and thus was not transferred. Here the original geographical record is corrected and the species is transferred to *Malacomorpha*. The resulting new combination, *M. cancellata* **comb. nov.**, resulted from examination of specimens from state of Rio Grande do Norte, Brazil. In addition, species diagnosis, redescription of the female and the first description of male specimens, with comparative comments on other *Malacomorpha* species, are provided.

KEY WORDS. Entomology, Neotropics, phasmids, taxonomy.

INTRODUCTION

Olcyphides cancellatus Redtenbacher, 1906 was originally described based on a single female specimen from Canton, China. Its type-locality was mentioned with a question mark. Later, Weidner (1966) transferred *O. cancellatus* to *Pseudolcyphides* Karny, 1923, while failing to acknowledge that there was a problem with the type-locality. Conle et al. (2008) synonymized *Pseudolcyphides* with *Malacomorpha* in their revision of *Malacomorpha*, but failed to mention *Pseudolcyphides cancellatus* in their work, leaving the generic placement of the species in question. Hennemann et al. (2008) confirmed that the type-locality given for *O. cancellatus* was in fact in error and that the species is most likely from the Neotropical region.

This series of events involving *Pseudolcyphides cancellatus* resulted in three problems: (1) the species cannot be properly identified because its description is insufficient for diagnosis, (2) only one specimen is available for study and, and (3) the generic position of the species is uncertain.

In view of museum material identified as the species in question (from the state of Rio Grande do Norte, Brazil, after comparison with photographs of the holotype), we present an amended geographical distribution for it, a redescription of the female, the first description of the male, a new combination, information on copulatory behavior and host plant.

MATERIAL AND METHODS

This study is based on the examination of 72 specimens housed at Coleção Entomológica Adalberto Antonio Varela Freire, Universidade Federal do Rio Grande do Norte (CEAAVF/UFRN). The specimens are stored in vials containing 80% alcohol. Male specimens had their terminalia dissected and then macerated in 85% lactic acid heated at 120 °C for about two hours. The macerated piece was examined on concave slides with glycerin. After study, the genitalia was placed in a microvial with glycerin and stored together with the specimen. Genitalia terminology follows Helm et al. (2011). All measurements were taken with a digital caliper rule data of the shortest and longest specimen are given.

Photographs were taken with a Leica DFC500 digital camera fitted on a Leica MZ205 stereomicroscope connected to a computer loaded with the Leica Application Suite software. This software includes an Auto-Montage module (Syncroscopy software) used to combine multiple layers of photographs taken

at different focus points into one photograph with greater depth of field. Label data are translated to English. Square brackets are used to indicate complementary data and semicolons are used to separate different specimens or groups of specimens.

The Brazilian specimens were compared with photographs of the holotype available at http://phasmida.speciesfile.org (Brock et al. 2016). The holotype is deposited in the Zoologisches Institut und Zoologisches Museum der Universität Hamburg (ZMUH), Germany. After study, part of the material was deposited at Coleção de Invertebrados do Instituto Nacional de Pesquisas da Amazônia (INPA) and Museu de Zoologia da Universidade de São Paulo (MZUSP). All specimens are in alcohol.

TAXONOMY

Malacomorpha Rehn, 1906

Malacomorpha Rehn, 1906; Zompro 2004 (key); Conle et al. 2008 (revision and synonymy); Brock et al. 2016 (catalogue).
Anisomorpha Gray, 1835; Bradley and Galil 1977 (taxonomy). Synonymized by Conle et al. (2008).

Type-species. *Malacomorpha androensis* Rehn, 1906 (Pseudophasmatidae): 113–114, fig. 2, by original designation.

Malacomorpha cancellata (Redtenbacher, 1906), comb. nov.

Figs 1–17, 19–30.

Olcyphides cancellatus Redtenbacher, 1906; Zompro 2002 (notes on holotype).
Pseudolcyphides cancellatus; Weidner 1966 (note on holotype); Hennemann et al. 2008 (geographical record); Brock et al. 2016 (world catalogue).

Diagnosis. Antenna with antennomeres alternating yellow and black from base to apex (Figs 4, 6). Pro- and mesonotum with three longitudinal and parallel black stripes (Figs 1, 7). Tegmina with white band between radial and medial veins (Figs 8, 14). Femora, tibiae and first tarsomeres alternating yellow and black from base to apex (Figs 3, 13–15, 19–21). Metasternum with black spots from apex of basal third to apex of median third (Figs 2, 9, 11, 15, 21). Sternites with irregular-shaped complex of spots at distal half (Figs 2, 10, 12, 15, 21).

Redescription. Females from Natal, Brazil, and holotype specimen (Figs 1–5, 7–10, 13–17, 30). Head. Frons and vertex dorsally smooth, yellow with black stripes (Fig. 13). Face yellow. Clypeus rectangular. Labrum U-shaped. Gena black (Figs 4, 14). Antennomeres covered by short setae, with color alternating yellow and black from base to apex (Figs 13–15). Ocellum present. Compound eye globose, black, dorsally with yellow stripes. Labial and maxillary palps yellow, covered by setae.

Thorax. Pronotum rectangular, 1.4 times longer than wide, rugged, yellow with three longitudinal and parallel black stripes (Figs 1, 7, 13). Mesonotum rectangular, 1.5 times longer than pronotum (Figs 1, 7, 13). Propleuron black, smooth. Mesopleuron triangular, black, with yellow stripe at apex of apical third, rugged (Figs 4, 14). Prosternum rugged, yellow, anteriorly trapezoidal, posteriorly rectangular. Mesosternum smooth, rugged, yellow with black spots (Figs 2, 15). Metasternum smooth, yellow, with black spots from apex of basal third to apex of median third (Figs 2, 9, 15).

Legs. Covered by setae laterally. Coxae and trochanters black. Anterior femur black except yellow dorsally at basal third. Anterior tibia with basal third yellow, remaining black (Figs 13–15). Mid femur yellow at proximal half, with small black spot at base; distal half black (Figs 1, 14, 15). Mid tibia with basal third yellow, remaining black (Figs 13–15). Posterior femur yellow at basal and medial third, black at apical third (Figs 13–17). Tarsi with first tarsomeres alternating black and yellow; black from second to fifth tarsomeres (Figs 3, 13–15).

Wings. Tegmina black, elongated, two times longer than broad, with several longitudinal and transversal yellow veins; shoulder elevated, with white band between radial and medial veins (Figs 8, 14). Posterior wing six times longer than tegmina, costal area black with longitudinal and transversal yellow veins (Figs 13, 14); anal area reddish in live specimens and whitish in preserved specimens.

Abdomen. Laterally covered by small setae. Tergites 1–2 dorsally yellow, without spots; tergites 3–10 yellow with black spots apically. Tergites 2–7 dorsally rectangular, 1.5 times longer than wide. Tergites 8–9 dorsally trapezoidal, with arched spots at apex. Tergite 8 laterally rectangular, 1.3 times longer than high (Figs 5, 16). Tergite 9 laterally rectangular, 1.2 times higher than long (Figs 5, 16). Tergite 10 dorsally with straight basal margin, lateral margin convex and apical margin arched; laterally with basal and lateral margin straight, apical margin curved (Figs 5, 16). Sternites with irregular-shaped complex of spots at distal half (Figs 10, 15). Sternites 2–7 rectangular, two times longer than wide; sternite 2 yellow, gradually turning black from sternite 3 to sternite 7 (Fig. 15). Subgenital plate sword-shaped, with basal margin straight, lateral margin sinuous and apical margin acute; proximal half broad, gradually narrowing from base to apex of distal half; elongated, 1.5 times longer than broad; black with yellow spots, covered by setae (Fig. 17). Cercus slender, straight, narrowing from base to apex, covered by setae (Figs 16–17).

Measurements (mm). Body length 70.4–71.2; pronotum 3.9–4.1; mesonotum 9.4–10.0; anterior femur 11.0–11.8; anterior tibia 10.2–10.3; mid femur 8.4–8.5; mid tibia 6.7–6.8; posterior femur 12.3–12.5; posterior tibia 11.3–11.5.

Description of males (based on specimens from Natal, Brazil). Similar to female, but with shorter and slender body and with the following differences.

Thorax. Black stripes at pro- and mesonotum and white band in tegmina thinner. Mesosternum without black spots. Black spots of metasternum with lighter coloration. Abdomen. Tergite 8 dorsally quadrangular, laterally two times longer than high (Figs

Figures 1–5. *Malacomorpha cancellata* comb. nov. female holotype: (1) habitus, dorsal view; (2) idem, ventral view; (3) idem, lateral view; (4) head, pro- and mesothorax, lateral view; (5) apex of abdomen, lateral view. All photos are a courtesy of Paul D. Brock and all copyrights belong to the Zoologisches Institut und Zoologisches Museum der Universität Hamburg (ZMUH).

Figures 6–12. *Malacomorpha cancellata* comb. nov.: (6) male head, pro- and mesothorax, lateral view; (7) female pro- and mesothorax, dorsal view; (8) female meso-, metathorax and wings, lateral view; (9) female metathorax, ventral view; (10) female sternite 2, ventral view; (11) male metathorax, ventral view; (7) male sternite 2, ventral view. Scale bars: 6, 11, 12 = 2.0 mm, 7–10 = 2.5 mm.

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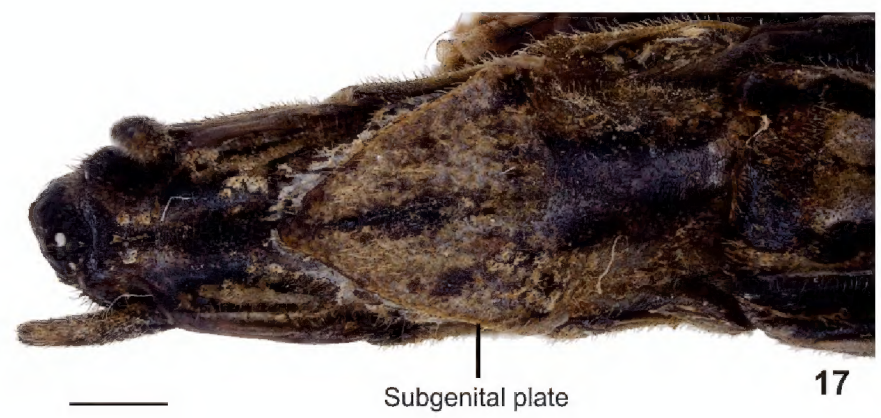

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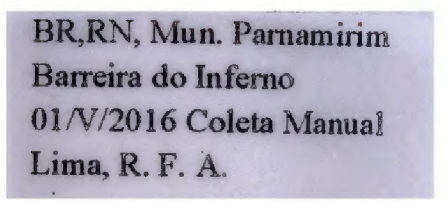

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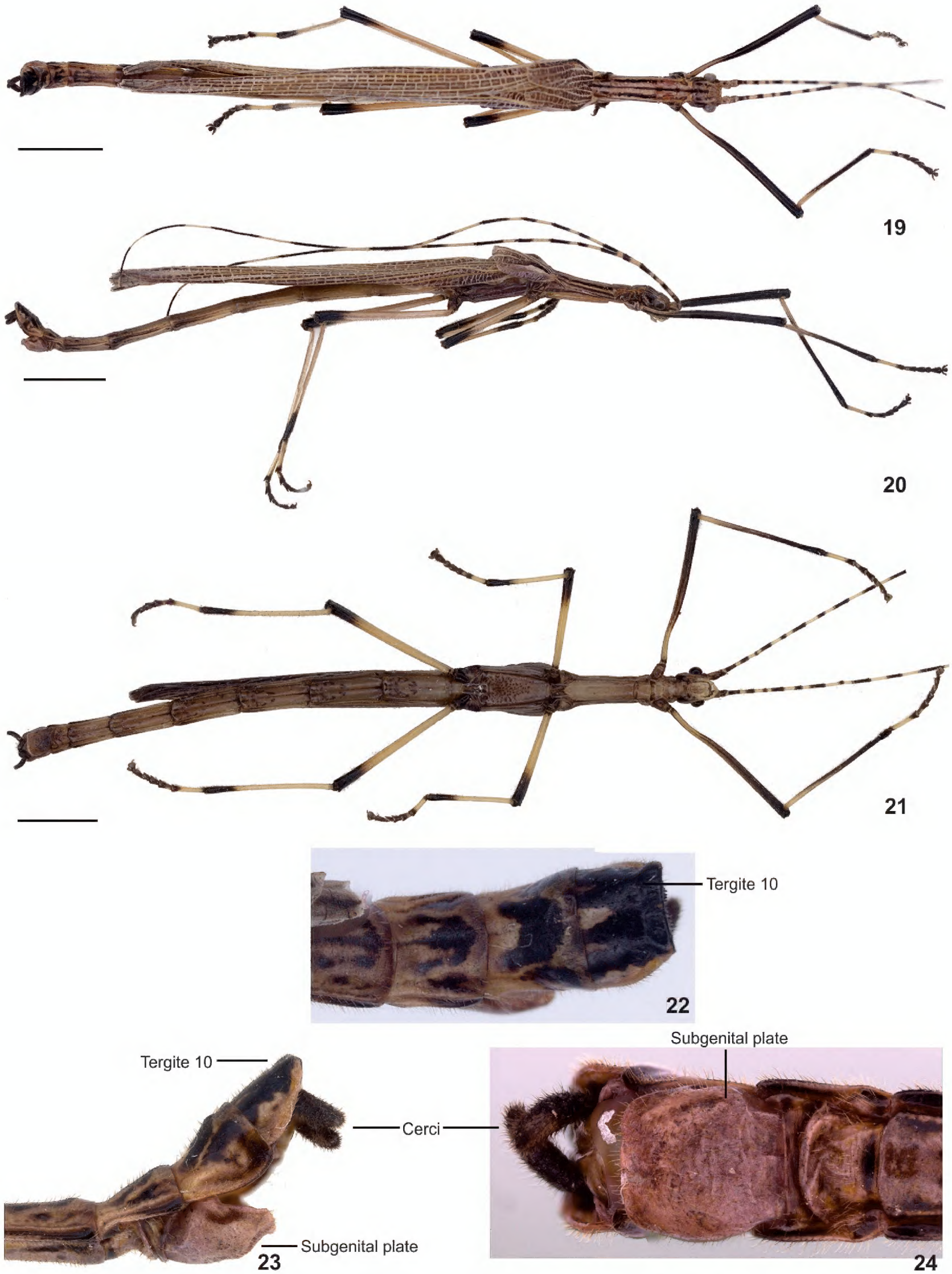
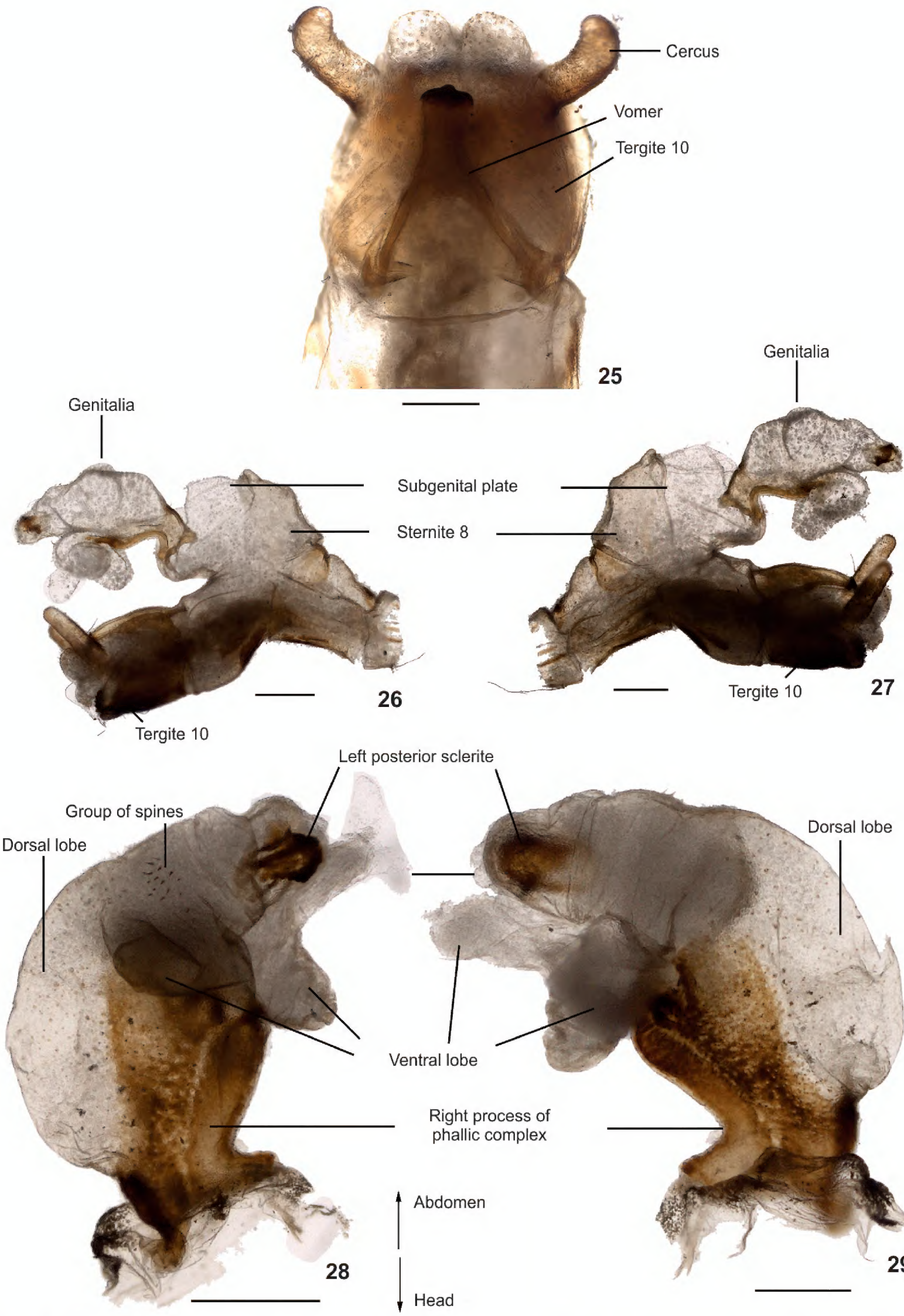
Figures 13–18. *Malacomorpha cancellata* comb. nov., female and specimen label: (13) habitus, dorsal view; (14) idem, lateral view; (15) idem, ventral view; (16) apex of abdomen, lateral view; (17) idem, ventral view; (18) specimen label. Scale bars: 13–15 = 5 mm, 16, 17 = 1 mm, 18 = 2 mm.

22–23). Tergite 9 dorsally and laterally trapezoidal (Figs 22–23). Tergite 10 dorsally rectangular, 1.4 times wider than long, with straight basal margin and lateral margin, apical margin slightly emarginated medially and projected laterally (Figs 22–24). Abdominal sterna yellow. Sternite 7 1.5 times longer than wide (Fig. 21). Sternite 8 with straight basal margin, lateral margin broadening towards apex, apical margin arched, convex (Fig. 24). Subgenital plate ventrally quadrangular, with straight basal margin, curved lateral margin, and straight apical margin; rugose, covered by setae (Fig. 24). Cercus robust, cylindrical, curved, covered by small setae (Figs 21–24). Vomer broad at basal third, narrowing at median third towards to apex; apex curved upwards (Fig. 25).

Genitalia. Connected to subgenital plate by two anterior points, pouch-like shaped and globose, mostly membranous, with some sclerotized parts (Figs 26–27), divided into two big lobes, dorsal and ventral. Dorsal lobe dorsally with small and scattered setae; dorsoapically with group of spines; antero-ventrally with sclerotized and sinuous right process of phallic



Figures 19–24. *Malacomorpha cancellata* comb. nov., male – specimen used: Parnamirim, Barreira do Inferno. 01.v.2016: (19) habitus, dorsal view; (20) idem, lateral view; (21) idem, ventral view; (22) apex of abdomen, dorsal view; (23) idem, lateral view; (24) idem, ventral view. Scale bars = 5 mm.



Figures 25–29. *Malacomorpha cancellata* comb. nov., male terminalia and genitalia – specimen used: Parnamirim, Barreira do Inferno. 01.v.2016: (25) apex of terga, ventral view; (26) Apex of abdomen with genitalia, right lateral view; (27) idem, left lateral view; (28) genitalia, left dorsolateral view; (29) idem, right dorsolateral view. Scale bars: 25, 28, 29 = 0.5 mm, 26, 27 = 1.0 mm.

Figure 30. *Malacomorpha cancellata* comb. nov., mating couple. Photo is a courtesy of Willianilson Pessoa.

complex; apically with well sclerotized, ellipsoidal left posterior sclerite (Figs 28–29). Ventral lobe divided into two ellipsoidal parts (Figs 28–29).

Measurements (mm). Body length 41.1–41.7; pronotum 1.8–2.0; mesonotum 3.4–3.7; anterior femur 8.8–9.1; anterior tibia 7.4–7.5; mid femur 5.7–5.8; mid tibia 5.3–5.4; posterior femur 8.2–8.3; posterior tibia 9.0–9.1.

Variations. The most noticeable variations are in the color of the antennomeres and legs, which can vary from dark to light yellow. Some male specimens have a lighter pigmentation of the thoracic and abdominal spots.

Material examined. Brasil, *Rio Grande do Norte*: Natal (Parque das Dunas Costeiras do Natal), 13.iv.1984, 29 females, Varela-Freire, A.A. leg. Collected manually on Ubaias [*Eugenia pyriformis* Cambess. (Myrtaceae)] (CEAAVF); same data but 3.vi.1984, 3 males, Varela-Freire, A.A. leg Collected manually on Ubaias (CEAAVF); same data but 3.vi.1986, 2 males, 2 females, A. A. Freire leg., Collected manually on Ubaia (INPA); same data but 05.iv.1989, 3males2females (INPA); Parnamirim (Barreira do Inferno), 19.iii.2009, 1 females, Oliveira, D.V. leg. (INPA); Parnamirim (Coabinal), 25.iv.2009, 1 male, Magalhães, L.B. leg. (INPA); (Parque das Dunas), 15.vi.2010, 1 female, Soares, A.M. leg. (INPA); Goianinha (Usina Estivas), 30.iv.2011, 1 female Brito, M.M. leg. (INPA); same data but 26.iv.2011, 1male, Dantas, A.K. leg. (INPA); Parnamirim (Pium), 23.v.2015, 1 male, Silva, J. leg. (INPA); Baia Formosa (Mata Estrela), 14.iii.2016, 1 male, 1 female, Silva, G.M. leg., collected manually on dune (INPA); Natal (UFRN, Mata dos Saguis), 20.iii.2016, 1 female, Garcia G.S. leg. (INPA); Parnamirim (Barreira do Inferno), 1.v.2016, 1female, Silva, F. leg. (INPA); idem, 1male, Coutinho, J.R.S. leg. (INPA); same data but 1 female, Lima, L. leg. (INPA); Natal (Parque das Dunas, zona interdunal), 03.vi.1984, 5 males, 5 females, A.A. Freire, leg., collected manually on Ubaia (MZUSP); Parnamirim, 30.iv.2009, 2 females, Oliveira, D.V. leg. (MZUSP); Natal [actually Parnamirim] (Barreira do Inferno), 11.vi.2009, 1 male, 1 female, Damião Valdenor de Oliveira leg. (MZUSP); Parnamirim, 29.iv.2010, 2females, Oliveira, C.A.S. leg. (MZUSP); Parnamirim, 2.v.2010, 1female, Lima, G.R.R. leg. (MZUSP); Natal, (Ponta Negra), 11.vi.2011, 1female, Bezerra, A.M. leg. (MZUSP); Parnamirim (Barreira do Inferno), 04.vii.2014, 01 female, Medeiros, A.G.N. leg. (MZUSP).

Biological information. A couple of individuals in copula were photographed in a forest fragment near the city of Natal (Fig. 30). The male was positioned adjacently to the female, the body turned almost upside down, clasping the female with its terminalia. The copula lasted approximately 45 minutes.

Known distribution. Brazil, *Rio Grande do Norte*: Natal, Baía Formosa, Goianinha, Parnamirim.

Remarks. The name of the genus comes from the Greek *Malakós* (soft, gentle) and *Morphé* (shape, form) and ends with the suffix "a", indicating that it is a feminine name. Thus, the specific name also has to be feminine. "Cancellatus" comes from the Latin and means latticed, being a masculine word. Therefore, we changed the specific name to "cancellata" to agree with the gender of the genus.

Conle et al. (2008) did not mention this species in their revision of *Malacomorpha* and hence they did not transfer it from *Pseudolcyphides* to *Malacomorpha*. Since they did not propose a new combination, the generic placement of this species remained questionable (i.e., whether it should be *Pseudolcyphides* or *Malacomorpha*). In addition, it is important to highlight that the specific name "cancellatus" had never been combined with *Malacomorpha* in a scientific publication before.

Although Brock et al. (2016) already used the combination "*Malacomorpha cancellatus*", it was used in an online digital database that does not constitute a formal scientific publication, since it is not registered with the Official Register of Zoological Nomenclature (ZooBank). According to the International Code of Zoological Nomenclature, this violates Article 8.5.3, which mandates that a valid electronic publication: "be registered in the Official Register of Zoological Nomenclature (ZooBank) (see Article 78.2.4) and contain evidence in the work itself that such registration has occurred." Thus, we are here treating this combination as new.

Malacomorpha cancellata comb. nov. has a striking and unique coloration pattern. In addition, it can be distinguished from the wingless *M. androsensis* Rehn, 1906, *M. bastardoae* Conle et al., 2008, *M. guamuhayaense* Zompro and Fritzsche, 2008, *M. jamaicana* (Redtenbacher, 1906), *M. macaya* Conle et al., 2008, *M. multipunctata* Conle et al., 2008, *M. obscura* Conle et al., 2008, and *M. sanchezi* Conle et al., 2008 by the presence of wings. Among winged species it differs from *M. cyllara* (Westwood, 1859) by having a wider and quadrangular subgenital plate (rounded in *M. cyllara*); from *M. hispaniola* Conle et al., 2008 by having longer and ellipsoidal tegmina (short and rectangular in *M. hispaniola*).

DISCUSSION

This is the first record of *Malacomorpha* from Brazil and South America. Thus it is an important record that increases the range of distribution from the Bahamas, Cuba, Hispaniola and Jamaica (Conle et al. 2008). It also strengthens the idea proposed by Hennemann et al. (2008) that this is definitively a Neotropical genus.

So far, the species has only been found in Brazil in the state of Rio Grande do Norte, in Atlantic Forest with traces of Caatinga and Dune vegetation. *M. cancellata* comb. nov. has been repeatedly collected since 1984 at Parque Estadual Dunas de Natal (a conservational urban forest fragment, located in Natal city, capital of Rio Grande do Norte) feeding on *Eugenia pyriformis* (Cambess.), commonly known in northeastern Brazil as "Ubaia" or "Uvaia". Parque Estadual Dunas de Natal is close to the sea and mostly harbors Atlantic Forest, but it also has traces of Caatinga and Dune vegetation. *M. cancellata* comb. nov. has also been reported from Dune areas inside and outside the park.

This habitat information is valuable because the Atlantic Forest and Caatinga biomes, as well as Dune environments, are critically endangered in Brazil. Less than 2% of the total area of the Caatinga is currently protected by conservational units (Tabarelli et al. 2000), and there is no reliable estimate of how much deforested the biome is. Concerning the Atlantic Forest, less than 15% of the original forest survived (Ribeiro et al. 2009). There are no reliable sources on how much of the Dune vegetation is being protected by conservational units, nor is it known how much of it has been already deforested. Hence, it is possible to assume that *M. cancellata* comb. nov. is also endangered, especially if it has become a specialist species in these biomes. Future studies are needed to evaluate whether *M. cancellata* comb. nov. is endangered or not. Lastly, this is the first record of the host plant and copulatory habits of *M. cancellata* comb. nov., as well as the first description of the male genitalia of *Malacomorpha*.

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